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REPORT 7/54

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Velocity of Detonation, VIII.

Variation of Velocity with Proportions of RDX/TNT

M. J. W. Billings

Safety in Mines Research Establishment, Buxton

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A.R.E. REPORT 7/54

Velocity of Detonation, VIII. Variation of velocity with
proportions of RDX/TNT

by

M.J.W. Billings

Approved

..... *H. Titman* for Director, S.M.R.E...... *D. Blackmore* Senior Superintendent, A.R.E.

Buxton Report E.204

January 1954.

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SUMMARY

The velocities of detonation of unconfined charges of three RDX/TNT mixtures viz. 60/40, 50/50, 40/60 have been measured.

It is found that the limiting velocity of detonation increases linearly with increasing percentage of RDX over this range of mixtures. The effect on velocity of detonation of reducing the diameter of the bare charge is least with the 50/50 mixture.

INTRODUCTION

Knowledge was required of the variation in limiting velocity of detonation with changing composition of mixtures of RDX and TNT. Three mixtures were chosen, viz. 60/40, 50/50 and 40/60 RDX/TNT, and charges were cast in long cylinders of various diameters. The velocities of detonation of the bare charges were then measured by means of a rotating-mirror camera.

Preliminary experiments showed that a charge of RDX/TNT 50/50 31.7 mm. in diameter was not initiated by a commercial No. 6 copper detonator touching one end of the cylinder, but was initiated when the detonator was inset in the charge. To ensure full detonation the charges for the determination of the velocity of detonation were initiated by a CE pellet 6.35 mm. long and having the same diameter as the charge.

RESULTS

The results for RDX/TNT 60/40, 50/50 and 40/60 are given in Tables 1, 2 and 3 respectively, and are shown graphically in Fig. 1. It was difficult to cast cylindrical charges 11.5 mm. in diameter and it was impossible to obtain charges of smaller diameter owing to their extreme brittleness.

TABLE 1 - Velocity of detonation of RDX/TNT 60/40

Charge diameter, mm.	44.20	32.00	25.45	20.00
Density, g./cm. ³	1.647	1.643	1.634	1.653
V.O.D., m./sec.	7869 7852 7847 7839 7782 7764	7782 7764 7756 7739 7722 7715	7727 7715 7715 7705 7688 7688	7717 7700 7695 7695 7690 7671
Mean V.O.D.	7825	7746	7706	7695
Range	105	67	39	46
Standard deviation	42	26	16	15
Coefficient of variation, %	0.54	0.33	0.21	0.19

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TABLE 2 - Velocity of detonation of RDX/TNT 50/50

Charge diameter, mm.	32.00	25.45	22.00	19.00	16.65	14.55	11.50
Density, g./cm. ³	1.664	1.658	1.676	1.671	1.664	1.686	1.627
V.O.D., m./sec.	7773 7759 7709 7658 7656 7615	7778 7736 7695 7678 7649 7649 7646 7632 7624 7600	7773 7768 7705 7705 7659 7658 7632 7620 7600 7596 7589 7555	7688 7663 7653 7639 7627 7593	7695 7685 7663 7658 7581 7550	7671 7671 7632 7562 7539 7532	7649 7610 7501 7496 7480 7463
Mean V.O.D.	7695	7669	7655	7644	7639	7601	7533
Range	158	178	218	95	145	139	186
Standard deviation	63	54	70	33	59	65	77
Coefficient of variation, %	0.82	0.71	0.91	0.43	0.77	0.85	1.02

TABLE 3 - Velocity of detonation of RDX/TNT 40/60

Charge diameter, mm.	44.20	30.00	25.45	20.00
Density, g./cm. ³	1.629	1.632	1.640	1.634
V.O.D., m./sec.	7612 7596 7538 7520 7501 7448	7517 7462 7452 7418 7400 7394	7553 7502 7454 7450 7444 7410	7385 7380 7377 7354 7351 7337
Mean V.O.D.	7536	7441	7469	7364
Range	164	123	143	48
Standard deviation	61	49	51	19
Coefficient of variation, %	0.81	0.66	0.68	0.26

DISCUSSION

During an examination of the effect of impurities on the velocity of detonation of T.N.T. (Titman & Billings, 1952) it was found that the relationship between the squares of the reciprocals of velocity of detonation and radius of charge was linear. The limiting velocity of detonation could be accurately deduced from this line by making $1/R^2 = 0$, i.e. by assuming a charge of infinite radius. A similar relationship holds for the three mixtures of RDX/TNT and from the best straight lines the limiting velocities of detonation have been deduced. The values, together with the mean observed velocities of detonation at the various diameters are shown in Table 4.

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TABLE 4 - Mean velocities of detonation at different diameters and calculated limiting velocity

Mixture RDX/TNT	Limiting V.O.D.	Diameter of charge, mm.								14.55	11.50
		44.2	32.0	30.0	25.45	22.0	20.0	19.0	16.65		
60/40	7830	7825	7746		7706		7695				
50/50	7704		7695		7669	7655		7644	7639	7601	7554
40/60	7566	7536		7441	7469		7364				

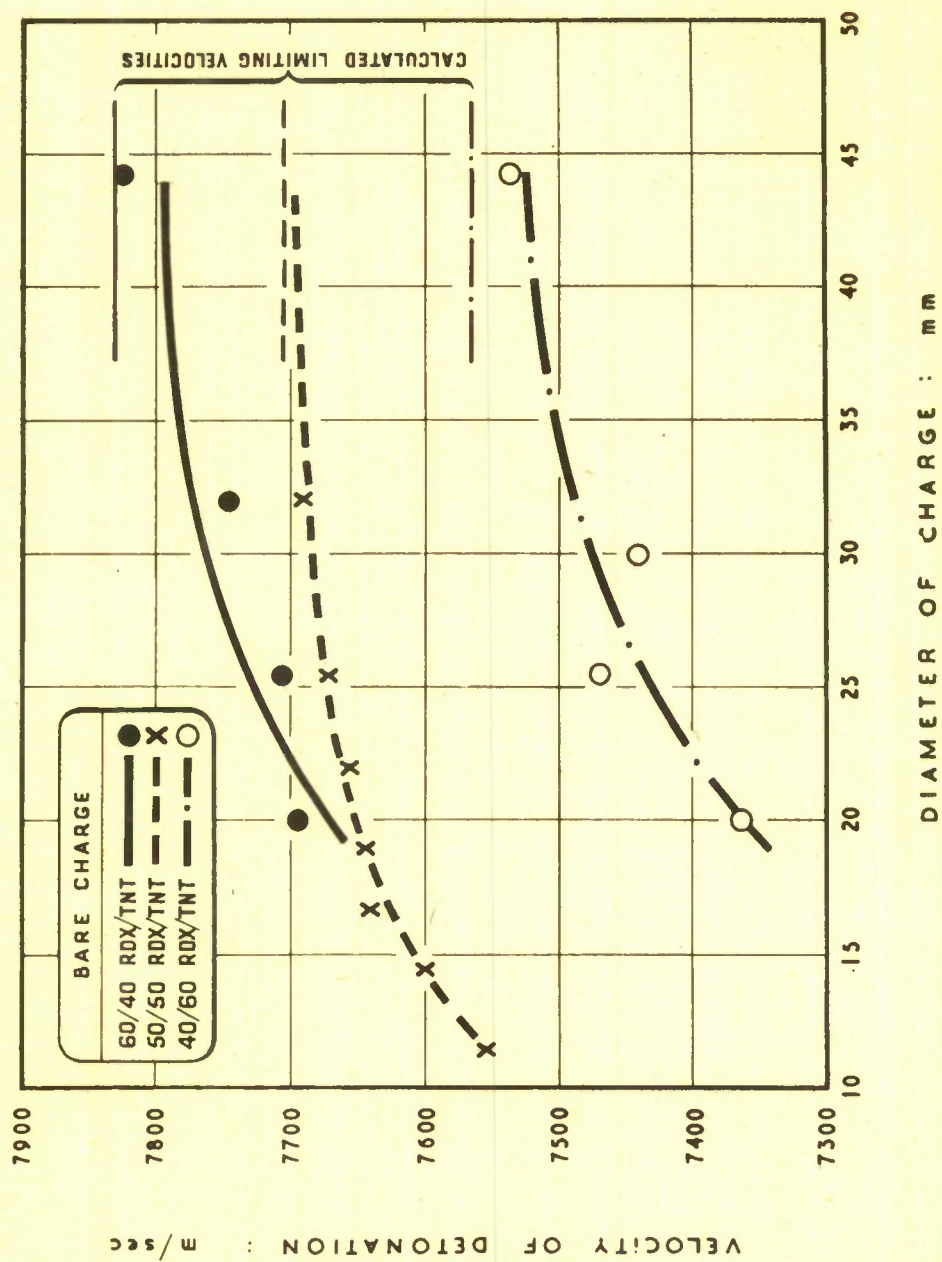
Over this rather restricted range of mixtures the limiting velocity increases by about 130 m./sec. for each increment of 10 per cent of RDX. The limiting velocity of grade I T.N.T. was found to be 7010 m./sec. (Titman & Billings, 1952), and this suggests that the increase might be linear over the whole range of mixtures.

The effect on velocity of detonation of reducing the diameter of the charge appears to be least marked with the 50/50 mixture. It also appears in these experiments that in this mixture the limiting velocity was attained in a bare charge of smaller diameter than in either of the other mixtures.

REFERENCE

Titman, H. and Billings, M.J., (1952) A.R.E. Report No. 17/52

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VARIATION OF V.O.D. WITH DIAMETER OF CHARGE

FIG. 1

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541.126.2:
662.238.1

Velocity of detonation. VIII.
Variation of velocity with
proportions of RDX/TNT.

A.R.E. Report 7/54

M.J.W. Billings January 1954

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